ENDOSCOPE MAGNETIC ROCKER SWITCH

FIELD OF THE INVENTION

The field of this invention is switches and more particularly Hall effect switches used on endoscopic devices for actuating a variety of functions.

BACKGROUND OF THE INVENTION

Endoscopes have become widely utilized in surgery for viewing body cavities and organs to permit performance of diagnostic and surgical procedures internally without the need for invasive surgical procedures. An endoscope is typically inserted through a small incision or portal providing access to the body cavity. A lens at a distal end of the endoscope is positioned to receive light reflected from a site to be observed, and images of the site can be viewed remotely to conduct diagnostic examinations and to perform closed, or endoscopic surgery. As used herein, the term endoscope refers generically to viewing devices for remotely observing otherwise inaccessible body cavities with minimal trauma and intrusion, including but not limited to arthroscopes, colonoscopes,

bronchoscopes, hysteroscopes, cystoscopes, sigmoidoscopes, laparoscopes and ureterscopes, etc.

Endoscopes are sometimes supplied with an eyepiece at the proximal end thereof, and relay lenses in the endoscope typically produce an image for direct viewing through the eyepiece. However, adaptation of video camera technology to endoscopy imaging has enabled the output image of an endoscope to be viewed on a video monitor. Specifically, a video camera is electronically coupled to the video monitor and optically and mechanically coupled with the proximal end of the endoscope. Indirect or video monitor viewing of endoscopic images provides numerous benefits over direct viewing through an eyepiece, including: protection of a direct viewer's vision from high intensity illumination passed through the endoscope and reflecting off bodily tissue; enhancement of operator comfort and freedom of movement; increased endoscope utility and efficiency; reduction in the time required to conduct many endoscopic procedures; simultaneous viewing of endoscopic images by more than one person; and recordation and real time transmission of images of surgical procedures.

Endoscopes allow the surgeon to view the surgical site during procedures through small incisions. Typically, the endoscope is used in combination with a video camera and a light source to enable the surgeon to view the output image on a video

monitor. External controls are typically provided on the camera to be operated by the surgeon. The surgeon can operate such controls to take a picture, control a video recorder, or to operate the camera to change its operating parameters. Hall effect sensors have been used in cameras in conjunction with switches to perform such operations as described above. Typically, the sensor is embedded in the inner camera housing which is distinct from an outer cover sleeve that contains the switch. The switch includes a magnet that is selectively brought in range of the sensor to change its output in proportion to the magnetic field strength. This change in sensor output can subsequently trigger the functions described above in furtherance of use of the endoscope and camera system. The operation of Hall effect devices depends on close proximity between the magnet and the Hall sensor. Because the Hall sensor is embedded in the inner camera housing with no mechanical or electrical connection with the external switch assembly, the camera can be autoclaved and effectively sterilized without any damage to the sensor or other internal sensitive electrical and optical components. The switch assembly is designed to facilitate sterilization and utilizes materials that can withstand the rigorous environment of repeated autoclave cycles.

Figure 1 illustrates an example of a known Hall effect switch used in endoscopes. The drawing is a section view through

the switch and the sensor. The sensor **10** is mounted in the inner camera housing **12** close to the surface **14**. Housing **12** has a recess **16** in which is deposited a switch assembly **18**. The assembly **18** comprises a receptacle **20** with a dome spring **22** residing near its lower end **24**. A magnet **26** sits on top of an actuator **28**. Actuator **28** has a tab **30** that engages the dome spring **22** when the surgeon pushes down on the button housing **32** that is retained in receptacle **20** by retaining ring **34** at thread **36**. In the switch of Figure 1 the switch is limited to enabling a single function. The use of a large mass of rubber for the button housing **32** dampens any audible sound made by the switch, when actuated, and severely reduces or eliminates the tactile feedback from the dome spring **22**. Another disadvantage is that the magnet **26** does not have completely predictable movements in response to pressure on the button housing **32**. Accordingly, its function is not always assured. Additionally, the switch shown in Figure 1 is relatively expensive to make.

Rocker switches and other types of switches that use magnets are shown in U. S. Patents: 5,523,730; 5,666,096 and 5,867,082 and in US Application US 2003/0067371 A1. What is needed in an endoscopic device is a switch that can handle multiple functions, using a single Hall sensor, while retaining the ability to provide tactile and audible feedback and ease of manufacturing. It needs to reliably position the magnet for

consistent switch operation and the overall assembly needs to be durable for the intended service. These and other advantages will be more apparent to those skilled in the art from a review of the preferred embodiment and the claims that appear below.

SUMMARY OF THE INVENTION

A rocker switch on an endoscopic camera allows multiple functions from a single Hall effect sensor. The switch features a neutral position between a rocked forward and a rocked back position. When the front of the switch is depressed a dome spring under the front is flattened and the magnet located in the rear is moved away from the sensor. Releasing the switch returns it to the neutral position. Depressing the rear of the switch brings the magnet closer to the Hall effect sensor while depressing another dome spring under the rear of the switch. Again, releasing the switch returns it to the neutral position.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a section view of a prior art switch for an endoscopic camera.

Figure 2 is a section view of a single Hall sensor embodiment of the switch, shown in the neutral position.

Figure 3 is the switch of Figure 2 shown in the rear-depressed position.

Figure 4 is the switch of Figure 2 shown in the front depressed position.

Figure 5 is a see through perspective view of an alternative design for the switch using two sensors and two magnets.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 2 illustrates the switch **38** in the neutral position. Switch **38** has a rocker **40** pivoted at **42** with rear undulations **44** and front undulations **46** on top surface **48**. A magnetic pin **50** is secured in a counter-bore **52**. The magnet **54** is disposed in cavity **56** and is secured to the magnetic pin **50**. Tab **58** extends down from rocker **40** toward dome spring **60**. Tab **62** extends from rocker **40** toward dome spring **64** near the front of switch **38**. In the neutral position of Figure 2, both dome springs **60** and **64** are slightly, equally compressed. The switch **38** is disposed in an outer housing **66** that slides over the camera body (not shown except for the Hall sensor **68** that is preferably embedded in the camera body or the housing).

In operation, the surgeon depresses the rear of the switch **38**, as shown in Figure 3. This forces a pivoting motion about pivot **42** as the dome spring **60** is flattened or depressed and the magnet **54** arcs closer to the Hall sensor **68** to trigger a first desired function of the switch **38**. When the switch is released by the surgeon from the Figure 3 position, it is returned to the neutral position of Figure 2 by the action of dome spring **60** releasing the stored force in it resulting from it being compressed into the Figure 2 position.

As shown in Figure 4, a push on the front of switch **38** flattens or depresses dome spring **64** and pivots the magnet **54** away from Hall sensor **68**. In this position another function of the endoscopic camera can be accomplished. Again, releasing the switch when it is in the Figure 4 position simply brings it back to the neutral position of Figure 2.

Those skilled in the art will readily see the advantages of this embodiment. The switch **38** can be set in the Figure 3 or Figure 4 position to accomplish different functions on the camera. These discrete functions are accomplished with a single sensor. The placement of the magnet **54** with respect to the sensor **68** is assured and is repeatable. The switch **38** is simple to construct and allows for reliable long-term operation. The dome springs **60** and **64** allow for audible and tactile

feedback. The switch automatically, returns to a neutral position when released.

Referring now to Figure 5, switch **70** pivots at pivot **72**. It features cavities **74** and **76** on opposite ends that are respectively in alignment with Hall sensors **78** and **80**. Magnets, not shown, are inserted into cavities **74** and **76**. Bores **90** and **92** are disposed on one side of pivot **72** while bores **94** and **96** are disposed on the other side of pivot **72**. Compression springs, not shown, are inserted into these bores to achieve a neutral position of the switch **70** where both the magnets are equally spaced from their respective Hall sensors **78** and **80**. Undulating surfaces **82** and **84** respectively on the rear **86** and the front **88** provide for an improved grip. In this embodiment two or more discrete functions are possible using at least a pair of magnets opposite a pair of Hall sensors **78** and **80**. All the other stated benefits of the embodiment of Figures 2-4 are also achieved in the Figure 5 embodiment. The primary difference is that additional magnets and sensors are used. The springs in the bores can be of a variety of types but coiled springs are preferred. As before, the switch **70** is installed in an outer sleeve that fits over the camera body that houses the Hall sensors. This allows the camera to be sterilized without affecting the sensors and the associated circuits that are sealed within the camera body. Still another embodiment includes

the Hall sensors mounted in the switch assembly and the magnets mounted in the inner camera housing. Similar to the previously described embodiments, the operation of the switch would either increase or decrease the proximity of the Hall sensor and magnet, providing the same functionality.

The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below.